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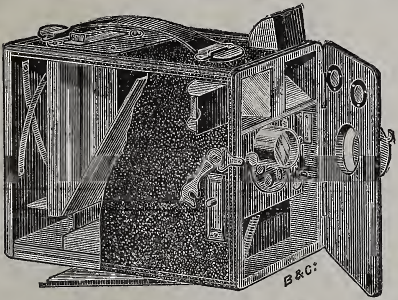

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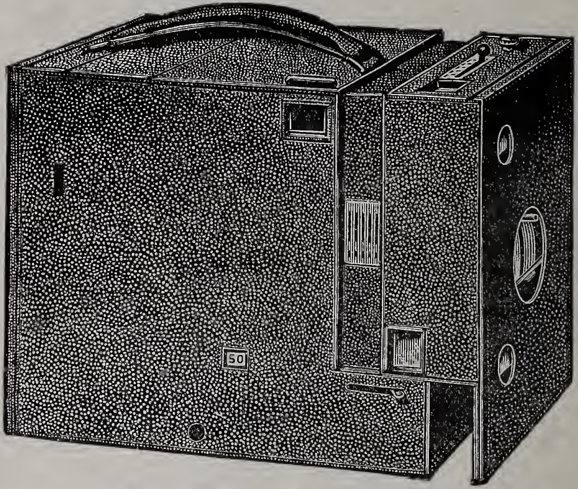

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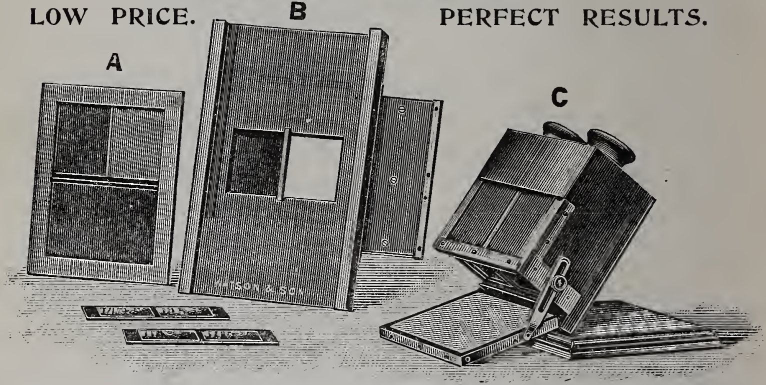

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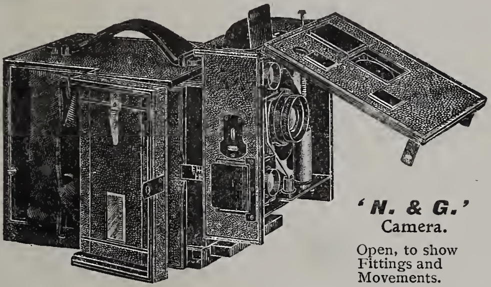

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OZOTYPE.

INTRODUCTORY.

There are still many people who, having undergone the operation of being photographed, would be thoroughly disappointed and would probably return the proof if the portrait were not printed on highly glazed P.O.P. or gelatine chloride of silver paper. We see this style of print outside every photographic studio and in every photographic print shop, and therefore it may be presumed that it meets the public taste to a very large extent. Platinotypes are decidedly popular, but the usual silver print still holds the field. And why is this? The reason is not far to seek—the vast majority of people have been accustomed for so many years to look upon a glazed silver print as a photograph pure and simple, and that nothing else is a photograph unless it is a silver print. They want the same thing that their fathers and mothers and uncles and aunts had; and although the photographs of their fathers and mothers and uncles and aunts may have faded away to a ghost, they say: "It is a pity, but I suppose it can't be helped; and the photographer charges such a lot for those in black, which he says will last for ever." In fact, the majority of people do not look upon a photograph as a work of art valued as such, but merely as a copy of themselves or friends, expressed in a way which is pleasing to them.

The ordinary amateur photographer appears to be satisfied if he collects a number of miniature views illustrating a pleasant time he may have spent on a holiday. Most of these are put away in a drawer to be occasionally looked at when friends call to see him. It is then a source of great pleasure to recall the various incidents connected with each subject. But some of the negatives may be so good, and the subjects of such value and importance, that it would be a pity if they were not made into permanent pictures of such a size that they might be hung on a wall or placed in a portfolio. It is in this connection that the value of Ozotype will be appreciated. If the small negative represents a pretty and artistic landscape, it might be enlarged up to whole-plate, 10 × 8, or 12 × 10 size, and a picture produced by Ozotype on any paper and in any colour that would suit the subject. All the artistic qualities of the negative will be brought out, and the result will be a very close resemblance to a water-colour drawing. The process is clean in working, and if desired can be done in easy stages—for instance, the paper can be sensitised one evening and exposed the next day, or any time within a fortnight or three weeks, and the washed print can be kept for months before being pigmented. If the printing does not appear to be correct, there is no need to spoil a pigment plaster over it—a fresh print should be made. When, after a few trials, the operator becomes proficient, he will find the work most fascinating and very easy to accomplish.

The ordinary P.O.P. or gelatine chloride print undoubtedly possesses a charm of its own, unrivalled by any other process. Its tone is rich, and its details are sharp and delicate in the extreme, and it is a pity its keeping qualities are not more reliable. But it only gives us a miniature, and does not look well in larger sizes than "cabinet," and is quite unsuitable for hanging on walls, as pictures, to be admired at a distance.

In the platinotype process it is possible to produce charming pictures of a fairly large size, but the colour is limited to either a cold black or a tint which is neither a true sepia nor any other definite colour.

In chloride of silver printing the action of light produces the colour; in platinotype the colour is thrown down after the image is printed; in carbon or pigment printing, however, a certain physical property is taken into consideration, in addition to the chemical change. The action of light on chromated gelatine, as is well known, renders the gelatine insoluble in hot water; and if the gelatine contains any insoluble powder, such as pigment, such insoluble substance will be held by the gelatine, which has been rendered insoluble by the action of light, and will form a layer of colour in a gelatine medium of different thicknesses, representing the half tones and shadows of the picture. This is what the artist does with his hand. He mixes his pigments with a colloid medium, and lays the colour on in varying thicknesses over his canvas to produce the desired effect.

In Ozotype the initial image is produced by photographic means, and the colour is laid down upon it, not with the brush, but by means of a thin surface of pigment incorporated in gelatine. The different depths of the printing in the initial photograph take the pigment in proportionate thicknesses, and thus a picture in pigment is produced possessing all the gradations of the original negative.

A picture produced by this means has

a breadth and quality which is lacking in a chemically produced image; and if made upon artists' drawing paper, will be scarcely distinguishable from monochrome hand work.

HISTORICAL NOTES.

As far back as 1839 Mungo Park showed that paper saturated with a solution of bichromate of potash and exposed to the sun's rays under a screen would produce a yellow picture on an orange ground, and when washed a white picture on an orange ground was obtained. In the following year, M. E. Becquerel performed the same experiment with the addition of iodide of starch, and found the surface more sensitive to light. In 1841 Joseph Dixon, of Massachusetts, used gum arabic in conjunction with bichromate of potash, and found that the gum was rendered insoluble on exposure to light.

In 1855, however, Alphonse Poitévin used another colloid substance—namely, gelatine, which he found was rendered insoluble by the action of light on bichromate of potash.

But the idea of mixing pigment with the colloid substance, which becomes insoluble by the action of light, and so imprisons the incorporated pigment, producing in this way the first carbon photograph, is due to Mr. Pouncey, of Dorchester. Mr. Pouncey's method, however, was defective in a most essential point. He simply spread the sensitive pigmented colloid upon paper and exposed it to light. The result was that on developing the print, only those portions of the image, where the negative had allowed the action of light to penetrate as far as the paper, were retained in the finished picture, and no half tones were produced. To remedy this defect, Mr. J. C. Bennett in 1858 exposed the pigmented paper from the back, but the process proved unsatisfactory.

It was, however, in 1864 that Mr. J. W. Swan solved the difficulty by patenting a method by which the sensitive pigmented gelatine was spread upon a temporary support and exposed to light. This gave a portable image, which was laid down upon another support, and after removal of the temporary support the back of the image was accessible, and was developed with warm water without any loss of half tone. This method was the most important improvement in carbon printing, and has carried the process up to its present high state of excellence.

Within the last few years two processes described as " carbon printing without transfer " have received considerable attention—namely, the Artigue process and the gum bichromate process.

Now let us see what the expression " without transfer " means. It means that the exposed surface of the pigmented colloid film is operated upon in development, the point which caused so much trouble in Pouncey's method. It may be granted that where the pigmented colloid is extremely thin, the details in the higher lights may possibly print through to the paper. But the development of the picture would have to be so carefully controlled, locally treated, and laboriously worked out that it would be next to impossible to produce two identical pictures from the same negative.

It has been asserted by some enthusiasts that the development from the back is a fallacy which has existed since Swan's remarkable invention. But why should gum bichromate and Artigue paper prints be so difficult to develop? and why should they require the brains and hand of an artist to make a picture? Because the sensitive film being so thin, the whole of the printing has penetrated as far as the paper, and the pigment being loosely held, the high lights and half tones depend simply upon the variation in the force exerted to remove the pigment.

The development from the back is the true scientific method, by which hundreds of identical pictures possessing perfect depth and half tone can be produced from the same negative. It will be seen that in Ozotype the formation of the gelatine image takes place on one surface of the film, and the development is carried out on the other.

It is a fact, which scarcely seems credible to most amateurs in photography, that by far the greater number of prints from negatives are made upon a sensitive surface composed of a bichromate salt and gelatine. For the production of the tens of thousands of what are called "process" illustrations in our daily and monthly magazines, and of the collotype pictures which we see in the shop windows and in railway carriages, and of the beautiful photogravures which adorn our walls, a bichromate salt is used to receive the impression of light. But up to the present time, in all the practical photographic printing processes in which a bichromate salt is used, that compound has always been employed in conjunction with an oxidisable organic substance, with the object of changing the property of such substance so as to make it resist the action of hot water or acids.

In Ozotype a new departure has been taken, and it will be seen that an oxidisable metallic salt is used in place of the organic colloid substance with the object of producing an image composed of two metallic oxides.

METALS OF THE IRON GROUP AND THEIR PHOTOGRAPHIC PROPERTIES.

The metals of the iron group are manganese, iron, cobalt, and nickel, but as chromium has a strong resemblance to these elements in its property of combining with oxygen, it will be considered as a factor in the group. They are all heavy metals and combine with oxygen in varying degrees, forming several oxides.

Chromium has 3 oxides, viz., Cr_3O_4, Cr_2O_3, CrO_3.
Manganese ,, 4 ,, ,, Mn_2O_2, Mn_3O_4, Mn_2O_3, MnO_2.
Iron ,, 3 ,, ,, Fe_2O_2, Fe_3O_4, Fe_2O_3.
Cobalt ,, 3 ,, ,, Co_2O_2, Co_3O_4, Co_2O_3.
Nickel ,, 2 ,, ,, Ni_2O_2, Ni_2O_3.

Of all these oxides, chromic trioxide, or chromic acid, is the richest in oxygen, and is the only oxide of the whole group which is soluble in water and has acid properties.

The affinity of chromium for oxygen is so great that Cr_2O_2 appears to be incapable of existing, and the highest oxide—namely, chromic acid CrO_3—very readily parts with a portion of its oxygen to organic matter. The formula of potassium bichromate is $K_2Cr_2O_7$ or K_2CrO_4 (CrO_3). Neutral potassium chromate is K_2CrO_4, so that a bichromate contains a molecule CrO_3 more than a neutral chromate, and no wonder it is more sensitive to light! The action of light in presence of oxidisable matter and water probably breaks its composition up into $K_2O+Cr_2O_3+O_3$; but the action does not appear to have been very satisfactorily determined.

With respect to manganese, this metal has no less than four oxides beginning lower in the scale and falling short of chromium by an atom of oxygen at the top. It forms a class of salt in which seven atoms of oxygen combine with two of the metal, having the formula $K_2OMn_2O_7$, called permanganate of potash, which, like chromic acid, readily yields a portion of its oxygen to organic matter, and also resembling it, inasmuch as it is sensitive to light.

If a solution of permanganate of potash and phosphoric acid be spread upon paper and exposed to light under a screen, the exposed parts will be found to have lost some of their oxygen. This can be shown by treating the surface with a solution of potassium iodide, when the unexposed parts will decompose the salt.

Some five years ago Messrs A. & L. Lumière pointed out before the French Photographic Society that the alkaline manganates and permanganates were sensitive to light, but they could not be photographically employed on account of their strong oxidising action. After many experiments with the salts of the higher oxides of manganese—which, by the way, are very unstable—the phosphate seemed to be the most promising. It appears from Messrs. Lumière's paper that manganic phosphate is troublesome to prepare, and that the coated paper is of a deep red colour. The printing must be done under a positive screen and is very slow, a couple of hours' sunshine being required to get a good print.

Subsequently Messrs. Lumière discovered that manganic lactate was the most convenient compound to use, and was much more sensitive to light than the phosphate. The preparation of manganic lactate appears to be troublesome, and sometimes of a violent character, and the coated paper is of a deep chocolate brown. The action of light takes place through a positive screen, and the image is of a lighter colour than the surface ground. The sensitive surface will not keep good for more than a few days. The development depends upon the oxidising action of those parts of the surface which have not been exposed to light, certain phenol and naphthol compounds being used which give colour on oxidation. The photographic action in the above cases is very simple. A part of the oxygen in the sensitive surface is very loosely associated with the manganese, and the impact of light and the presence of organic matter cause a withdrawal of the loosely held oxygen, so that the exposed parts are reduced to a salt of a lower oxide and are inactive.

If strong oxidising agents, such as chloride of lime, sodium hypochlorite, or potassium permanganate, are added to a solution of a salt of the monoxide of manganese or manganous chloride, a precipitate of manganic oxide is at once thrown down, but if a bichromate salt is used in this way, no precipitate is formed, and the solution will keep for a very long time, although free chromic acid gradually precipitates the oxide.

In Ozotype the more stable salts of the monoxide of manganese are employed, which are raised to an insoluble higher oxide by the action of light upon the chromium compound.

The salts of the higher oxides of iron are employed in photography to a very considerable extent. The beautiful and permanent platinotype process and the cyanotype, or blue print, process depend upon the elimination by light of a part of the negative element from a salt of a high oxide of iron.

On reference to the above tabular statement it will be seen that there are three oxides of iron, the highest (Fe_2O_3) not being so rich in oxygen as is the case with chromiun and manganese, although, like manganese, there is a higher oxide combined with an alkali base, namely, K_2OFeO_3, or potassium ferrate, which is, however, very unstable.

The photographic properties of cobaltic salts have lately been investigated, and the experiments are very interesting, inasmuch as the most sensitive compounds seem to be, as in the case of manganese, the organic salts of the high oxide.

The salts of the higher oxide of nickel probably possess photographic properties.

OZOTYPE.

THE chemical actions involved in this method of photographic printing being the transfer of nascent oxygen or ozone from one metallic compound to another under the influence of light, the name "Ozotype" was considered to be an appropriate one for the process.

Nearly seventy years have elapsed since the light-sensitive property of bichromate of potassium was discovered, and up to the present time it has been used almost exclusively, in conjunction with oxidisable organic substances, for the purpose of rendering such substances insoluble by the action of light. Oxidisable inorganic substances, such as salts of copper, nickel, and cobalt, have been employed, in conjunction with the bichromate salts, with the view of producing photographic images with more or less success; but the idea of using a combination of a chromic salt and an oxidisable metallic salt for the production of an image possessing oxidising properties does not appear to have been carried out.

The effect of light on nearly all light-sensitive substances is the withdrawal of a portion of the negative element from their composition. In the chloride and bromide of silver processes a portion of the chlorine or bromine is eliminated by light, and in the case of ferric salts, such as the chloride and oxalate, a portion of the chlorine or oxygen is removed.

With regard to the chromic salts, the same phenomenon occurs, a portion of the oxygen (the negative element) being withdrawn by the action of light. In the usual methods of photographic printing the product of reduction is alone made use of, the disengaged element not being taken into consideration, except for the purpose of finding something which will get rid of it. In Ozotype, however, the principal object is to preserve the disengaged element as well as the product of reduction, so that both may be subsequently utilised.

If we make a solution containing an acid chromic salt and a salt of the monoxide of manganese and spread it upon paper and dry it, a surface sensitive to light is formed, and if we place such a surface under a negative and expose it to light, a distinctly visible positive image of a brown colour will be the result. Now what has the light done? It has separated a portion of the oxygen from the chromic salt, which it has reduced to a very stable insoluble lower oxide called chromic oxide, or sesqui-oxide of chromium. But, what has become of the disengaged oxygen? It is well known in chemistry that the addition of active or nascent oxygen to a salt of the monoxide of manganese raises the lower oxide to a higher one, and the radicle is compelled to look out for another base. This is what occurs when light removes a portion of the oxygen from the chromic salt in the sensitive surface used in Ozotype. Before exposure to light the surface consists of two very soluble compounds—namely, a chromic and a manganous salt. After exposure under a screen, an insoluble image is produced, consisting of chromic and manganic oxides—in fact, the oxygen has passed from the chromic to the manganous salt, reducing the one and enriching the other. An image produced by this means has strong oxidising properties, and is exceedingly useful in many ways. The manganic oxide may at any moment be made to liberate the oxygen which light has given it, with the object of acting upon colourless aniline and other similar salts and so producing brilliantly coloured pictures, or the oxygen of the manganic oxide may be made to react upon the chromic oxide, converting it again into chromic acid, for the purpose of making pictures in pigmented gelatine.

Pictures in pigmented gelatine (or carbon pictures, as they are popularly called) are of a very permanent character. The colours can be selected from the best and most durable pigments used by artists, and it is well known that gelatine when dry is less liable to change than almost any organic substance. The pictorial effects which can be produced by pigment printing excel all other photographic printing methods. The pictures have a broad and most artistic appearance, and can be produced in a variety of monochromes with the certainty that the colour of the resulting picture will be that of the pigment used;—indeed, it is a natural inference that where pigment is employed to produce a photographic work, the result will be a near approach to that kind of work where the artist applies pigment with a brush.

It is proposed in this little treatise to confine the information and methods of procedure principally to the employment of Ozotype in the production of pigmented gelatine pictures. With regard to the application of the salts of aniline for the production of coloured images, one or two formulæ will be given, but I have not yet experimented much in this direction.

Nearly all the limited time at my disposal has been devoted to that application of Ozotype which I consider gives the most permanent and artistic results.

THE ORDINARY CARBON PRINTING PROCESS.

For the information of those who are not acquainted with the present method of carbon printing, I propose to give a short description of the process as it is now carried on.

Carbon tissue, which is paper thickly coated with gelatine in which pigment is incorporated, is rendered sensitive to light by the addition of a bichromate salt, either in the process of coating by machinery or by immersion afterwards. The sensitive coating of pigmented gelatine is exposed under a negative, and as there is no visible image during printing, an actinometer has to be used. When judged to be sufficiently exposed, the carbon tissue is removed from the printing frame and allowed to soak in cold water for about two minutes, until it has absorbed a certain quantity of water and no more. A piece of paper coated with insoluble gelatine, called "single transfer paper," having been previously placed under the surface of the same water, is brought in contact with the carbon tissue, and the two are drawn out clinging together and placed upon a flat surface, and firmly pressed together by means of a squeegee. After surface drying between blotting-paper, the carbon tissue, with its adherent transfer paper, is immersed in water at a temperature of 105° to 110° Fahrenheit, the backing of the tissue is pulled off, and the mass of gelatine which now adheres to the transfer paper is laved with the hand in a warm-water bath, until those portions of the pigmented gelatine which have not been acted upon by light are washed away.

This is called the single transfer process, and to explain the reason why it is so named it may here be pointed out that, if the carbon tissue carries an image which has been printed from an ordinary negative, the act of laying it face downwards upon another support, and developing it from the back, causes a reversed position of the picture with regard to right and left. This is an inconvenience in many cases, so that in order to bring the picture into its correct position, the image has to be developed upon a temporary support, and then laid down again upon its final support. This, as will be seen, involves an extension of the procedure, and is called double transfer. Of course a reversed negative can be used in the first instance, but then a reversed negative has to be made. This process is quite simple in the hands of those who are constantly working it, such as the manufacturers of the tissue, but to those who take it up occasionally it presents many difficulties.

There is no visible image during the progress of printing, and an actinometer has to be employed to judge the exposure. In the simpler of the two methods the picture is rendered in a reversed position with regard to the negative. A frame of black varnish or paper round the edges of the negative is required to prevent the deep shadows from washing up during development, and it is necessary that the surface, which is to be the permanent support of the picture, be coated with an insoluble medium, such as gelatine, to which chrome alum has been added. In the operation of development the warm-water bath becomes charged with the bichromate salt, which is deleterious to some fingers.

In the Ozotype method of pigment printing, any paper is made sensitive to light by coating it with a sensitising solution sold for the purpose, which will keep in good condition in the bottle for years. The photographic image is distinctly visible during the progress of printing. The initial image and subsequent picture are correctly rendered. The carbon tissue, or what will hereafter be called the "pigment plaster," is used in an insensitive condition, and therefore a stock can be kept on hand without fear of spoiling. No safe edge or means for preventing the edges of the picture from washing up is required, and there is no dipping one's fingers in a warm solution of a bichromate salt in the operation of development—and no blisters are formed.

OUTLINE OF THE OZOTYPE PROCESS OF PIGMENT PRINTING.

Paper is coated with the special sensitising solution and dried in the dark. The dried sensitive paper is exposed under a negative, and a plainly visible brown image is the result.

The print is washed until all soluble salts are removed. A piece of pigment plaster the size of the print is immersed in a solution containing acetic acid, hydroquinone, and ferrous sulphate, which is called the "acetic solution." The washed print is applied to the plaster under the surface of the acetic solution, and both are brought out clinging together, pressed in contact with a squeegee, and hung up to dry.

When dry, the print, with its adherent plaster, is allowed to soften in cold water for about half an hour, and then transferred to water at about 107° Fahrenheit. The backing of the plaster is removed, and the development of the picture is carried out by soaking and laving until all the gelatine that has not been rendered insoluble by the action of the acetic solution is washed away.

MATERIALS USED IN THIS PROCESS.

Paper.
Sensitising solution.
Pigment plaster.

NOTES ON THE SELECTION OF PAPER.

The foundation or support which is to hold the initial photograph and the subsequent picture is a most important item. Upon it depend the character and artistic quality of the resulting work. For pictures larger than whole-plate size nearly all the English and French drawing papers are suitable. The surface should be smooth, as it becomes slightly roughened in the development of the image. A variety of such papers are obtainable, and almost any taste can be gratified in this direction. Whatman, Arnold, O.W., Michallet, Lepage, and similar papers give broad and very pleasing effects. Very smooth superfine or calendered cartridge or collotype printing papers are useful for making neat and pretty pictures for whole-plate, 10 by 8, and 12 by 10 sizes.

But for quarter- and half-plate sizes a slight difficulty comes in. If the grain of the paper is shown, the delicate detail is too much broken up, and the appearance would not be pleasing to some workers. It is, therefore, necessary to look out for a sample in which the grain is hidden by some neutral substance. I find there is some difficulty in procuring such a paper. The highly glazed enamelled art chromo printing papers employed in lithography and process printing contain some substance that appears to be strongly alkaline, and which immediately decomposes the sensitising solution. Single transfer paper employed in carbon printing and also double transfer paper may be used by those workers who like a glossy surface, with extreme detail. I believe that a very fine surfaced collotype printing paper would give the most artistic results for small work. The surface of very fine paper generally contains a dressing, and care should be taken in sensitising that the surface is not disturbed in the operation of coating. However, the sensitising solution seems to harden the surface, which does not come off in the development. Baryta coated papers may be used, but the appearance of the resulting picture is not quite to my liking. There is a peculiarity about this paper which it may be advisable to mention. The sensitive surface when dry has not that brilliant yellow colour so characteristic of ordinary and gelatine surfaced papers coated with Ozotype solution. The image also is of a faint bluish brown, but nevertheless it is quite as active, and therefore should not be deeply printed. This fact is evidently owing to a certain absence of organic matter, which appears to have the property of colouring the image.

In the practical section of this treatise, an article will be found on "Sizing the Paper" previous to the application of the sensitising solution. Coating absorbent papers with a weak solution of gelatine does not imply that the gelatine will give a gloss to the picture. If the right paper be used, matt surfaces can be obtained just as well by using a weak solution of gelatine as upon the plain paper, and the sizing has the advantage of keeping the sensitising solution on the surface of the paper, thus securing brilliancy in the shadows. The most convenient dimensions of paper for carrying out the operations in Ozotype are 20 by 25 inches, which is what is called "Royal" size in printing papers. In drawing papers, however, the same term is applied to papers of 19 by 24 inches in dimensions.

THE SENSITISING SOLUTION.

The sensitising solution is a patented preparation, and is sold by photographic dealers ready for use. It is of such a density that it can be spread smoothly upon paper without penetrating into the substance; it will keep in the bottle for years without deteriorating; it is not sensitive to light while in solution, as it contains no organic matter. The light-sensitive surface which it forms will keep good on pure paper from two to three months, if preserved in the dark under pressure. Any superfluous solution that has been in contact with paper or any organic matter should never be poured back into the bottle.

The covering quantity for smooth paper is about two drams of the solution for three square feet of surface. Absorbent papers will require a little more.

THE PIGMENT PLASTER.

In the ordinary carbon process the paper coated with pigmented gelatine is called carbon tissue, a conventional term which is quite applicable to that process, as it is a kind of gelatine skin upon which the image is produced. In Ozotype the pigmented gelatine is not used in this way; it is not rendered sensitive to light, nor does it carry the image. It is applied like a plaster to the already-made image, this being by far the most convenient way of colouring the initial photograph. Therefore the paper, with its coating of pigmented gelatine specially prepared for this process, will be called "pigment plaster."

Arrangements will be made for selling the pigment plaster in a variety of colours, cut up in convenient sizes, to suit all classes of workers, and as it will keep indefinitely, a stock can be kept on hand without fear of spoiling.

PRACTICAL WORKING INSTRUCTIONS.

APPARATUS AND TOOLS REQUIRED.

Brush, for coating the paper with the sensitising solution. This should be a well-made, flat, soft, hog-hair brush, with a single rather full row of ground bristles made after the model of a camel-hair brush but longer in the bristle, and should be three to four inches wide. A varnish brush of this width is too heavy and too full of strong bristle to be useful. For coating dressed papers it is advisable to use a softer brush made of bear's hair, as the surface dressing of such papers is liable to get disturbed with strong brushes. The brush should be thoroughly washed in cold or lukewarm water before being put away.

Dish.—An ordinary porcelain photographic dish for holding the acetic solution, and when not in use for this purpose can be employed for the alum bath.

Developing Tank, such as is used in the ordinary carbon process. The dimensions, of course, will depend upon the size of the intended picture. It should be four inches larger each way than the size of the print to be developed. An ordinary enamelled iron pie-dish would be serviceable, but these are made rather shallow, and the dimensions never seems to correspond with photographic papers. However, any vessel of suitable dimensions that will stand heat will do just as well as a regulation developing tank.

Stove.—A gas or oil stove for raising the temperature of the acetic solution and heating the hot-water developing bath. Almost any of the numerous atmospheric gas heating stoves with flat tops will answer the purpose, and where gas is not available, a Beatrice paraffin-oil stove may be used.

Asbestos Cardboard, or a safe boiling stove mat, which can be purchased at many oilshops for a few pence, should be placed under the dish when raising the temperature of the acetic solution, to prevent the porcelain from cracking.

Tin Mug.—An enamelled iron mug with handle is very useful while developing, for the purpose of dashing the warm water over the print to facilitate the removal of the soluble gelatine.

Zinc Plates.—A few squares of thin sheet zinc, half an inch wider than the various sizes of the prints, form a capital support for the picture during development.

Thermometer.—This is essential, as the temperature of the acetic bath should be accurate, and it is also useful for the developing water.

Squeegee —This should be flat, a useful size being eight to ten inches.

Squeegee Board.—The ordinary carbon printing zinc squeegee board will do—in fact, any flat, smooth, non-absorbent surface answers the purpose, such as glass, *papier mâché* board, etc.

Pins, for fixing the paper to be sensitised on a board or table. They are also useful for hanging the squeegeed prints up to dry. Dark-room pins, sold by most photographic dealer's, answer the purpose admirably.

Velvet Brush, such as used for dusting photographic plates, is useful for wiping the surface of the plaster before immersion in the acetic bath. A piece of dry soft muslin will answer the purpose just as well.

Blotting Paper.—A quire of white blotting paper for surface drying the squeegeed prints.

SIZING THE PAPER.

It is well known that in order to produce brilliant prints in any photographic process, the sensitive medium should be kept well on the surface of the paper. If the Ozotype sensitising solution is applied to absorbent paper, the resulting picture will have a sunk-in, matt surface and dull appearance, which in many cases is quite artistic, especially for large work; but for small pictures, such as half- and whole-plate sizes, a preliminary coating of gelatine is advisable. The method of sizing is a very easy one. Make up the following solution :—

Nelson's opaque gelatine … …	1 dram
Cold water … … … …	5 ozs.

Let the gelatine soak in the water for about half an hour, then place the vessel in a saucepan half full of water, and heat to about 160° Fahrenheit. This will make a 2½ per cent. solution of gelatine. Now pin your paper on a table or board, and pour a moderate sized pool of the gelatine solution on to the middle; then, without losing any time, spread the solution over the surface by means of a flat hog-hair varnish brush. Rub the gelatine well into the paper until you have got a tolerably smooth surface, and hang up to dry. It will probably look a little streaky while drying, but it must be remembered that in subsequently coating it with the sensitising solution, the gelatine will undergo another churning, which will tend to make the surface quite smooth.

Another more convenient method is to use fish glue instead of the ordinary gelatine. A solution of fish glue can be kept ready for immediate use at any time, and the operation of coating is not so trying as when ordinary gelatine is employed. The solution may be—

Lepage's fish glue	1 oz.
Hot water	9 ozs.

Albumen may be used, but on no account should ammonia be added—in fact, no alkaline substance whatever should be brought in contact with the sensitising solution.

In this process the initial photographs or prints can be sized previous to pigmenting, if the object is merely to get the plaster to properly adhere to the image, but it is not recommended.

Surface-coated papers, such as enamelled collotype printing paper and single and double transfer papers, require no sizing, and there are some papers which are sufficiently sized in their manufacture even for small work.

The operation of sensitising sized papers is more easily performed if the sensitising solution is applied before the sizing is quite dry.

SENSITISING THE PAPER.

This operation can be performed in ordinary gaslight. It is a question whether the Welsbach incandescent light is not a little too strong.

A very convenient size for coating with the sensitising solution is about 25 by 20 inches, which are practically the dimensions of collotype and several of the thinner English papers. This size can be cut up into half-plate or whole-plate pieces without much waste. For large work where English drawing papers are used, the Imperial sheet can be coated without difficulty, as the surface of such paper takes the solution evenly. As a general rule a sheet measuring 25 by 20 inches takes nearly two drams of the sensitising solution, and an Imperial sheet 30 by 22 inches requires about three to three and a half drams. A useful fact to be borne in mind is that two drams of solution will fully cover three square feet of surface.

Now to begin work.

Place on a table a sheet of any white paper (wrapping paper will do) about three inches larger each way than the paper to be coated, and put the coating brush in a handy position on the same table. Take the paper to be coated and lay it down in the middle of the paper already on the table and pin down the four corners with dark-room pins. Now take the bottle of sensitising solution, and if the paper to be coated is Royal size (viz., 25 by 20 inches), pour exactly two drams into a graduated measure. Keep this in your left hand, go back to the table and take the coating brush in your right hand. Then throw the contents of the graduated measure on to the middle of the paper, and without losing any time drive with the brush as much of the pool as possible to the four corners of the paper, then, sweeping the edges first, spread the solution all over the surface of the paper as rapidly as possible, finishing up with light vertical and horizontal strokes until the whole surface is quite evenly coated. The pool of solution when thrown down should be spread over the surface immediately, or it may soak into the paper and cause a mark. It is astonishing how quickly a sheet of paper can be coated, and how soon the practice is acquired. If the paper has been previously sized with soluble gelatine and dried, a rather vigorous rubbing will be required, as in this case the gelatine mixes with the sensitising solution. It is, however, easier and more economical to apply the sensitising solution to sized papers before the gelatine is quite dry.

When coated, the paper should be hung up on a line, by means of wooden clips, in a room rigorously protected from daylight. However, a candle or a gas jet half turned on may be used to give sufficient light by which to hang the paper up. The coated paper will take about fifteen to twenty minutes to dry, and it can then be cut up into the required sizes and stored away in waxed wrapping paper enveloped in brown paper, or it may be used for printing at once. It is, however, better to keep it a day before exposing it. The sensitive surface on pure paper will keep in good condition from two to three months, if carefully preserved in waxed paper and subjected to slight pressure. However, it is better not to keep the sensitive surface on untried papers for more than a week or ten days.

Do not forget to wash your coating brush thoroughly in clean water before putting it away.

CUTTING UP THE SENSITIVE PAPER.

As soon as the sensitive paper in the dark room is dry, it may be cut up into the required sizes. The best way of doing this is to bring a sheet from the dark room and lay it sensitive surface downwards upon the paper which was used as a substratum during coating, the same amount of light being permitted as in the sensitising process, provided that the sensitive surface is kept away from the light. The paper will now lie tolerably flat, so that pins may not be necessary. Now take an old negative of the size required and plan out on the back of the paper the most economical way of cutting it up. A margin of about half an inch round the edges of the sheet should not be used, in case of the coating being uneven. When this is done, use the old negative as a gauge by drawing on the paper with a pencil a line round the edges of the glass plate, and mark each space with the date of sensitising. Then with a pair of long scissors cut through the pencil lines and put the cut pieces at once in a drawer or box, and close the lid against the light.

THE BEST NEGATIVE.

When a chromic salt is used as a light-sensitive surface, the action of light through the dense parts of a negative is stronger than in the case where silver compounds are used. It would therefore follow that a rather strong negative is desirable. This would be the case if we were limited to only one formula for the acetic solution, but by varying the ingredients of this remarkable re-agent we can produce strong prints from weak negatives, and pictures with fairly soft effect from hard negatives. Of course the proper and the surest way to work is to use a negative which will give the best results with a normal acetic solution, and the most suitable negative is one entirely free from fog or veil, such as that which gives the best results in platinotype or carbon. The contrast should not be too harsh and the small details should be clearly defined.

JUDGING THE EXTENT OF PRINTING OUT.

The colour of the print-out image is light brown—in fact, pure khaki; but as it is seen on a bright yellow ground, a little experience is necessary in judging the extent of printing.

In the case of images produced from

brilliant negatives, there is no difficulty, as the printing is very plainly visible. But in exposure under thin negatives care should be taken that the high-lights are not printed through. On opening the back of the printing frame look only at the highest light, and as soon as you see the details faintly, the printing is sufficient. Never mind how strong or faintly the shadows show—the appearance of the high-lights is the criterion.

The time occupied in printing is as nearly as possible that required for platinotype, and the printing out is judged precisely in the same manner. With papers where starch is used as the sizing material the image is of a bluish-brown colour, and with Baryta coated papers the image is very faint, but it is as active as if it were a deep brown colour.

A perfect khaki-coloured print-out photograph can be produced by exposure under a negative such as is used in process work, but without the screen.

WASHING THE INITIAL PHOTOGRAPH AFTER EXPOSURE.

When the printing is finished for the day, the proofs should be washed in several changes of cold or luke-warm water until the yellow ground is perfectly white and the water colourless. This is a much simpler operation than washing out hypo, and should be done as follows:—

First water.—Allow the prints to soak ten minutes, keeping them moving about, and pour the water away to the very last drop.

Second change of water.—Ten minutes, and pour away to the last drop.

Third change of water.—Five minutes, and pour away to the last drop.

Then put the prints into another change of water, and they will be ready to be taken out and laid on blotting-paper to dry, or they may be surface-dried between blotting-paper to expedite the operation. When dry, the prints are ready for the pigmenting operation.

The washing should not take more than half or three-quarters of an hour in carrying out, and the prints should not be left soaking for hours.

Prints or papers that have been kept some time in a sensitive condition require more washing, and may be left a little longer in the water.

THE ACETIC BATH.

The solution which is devised to act upon the chromic and manganic oxides of which the initial image is composed, with the object of rendering insoluble the gelatine of the pigment plaster in contact therewith, is the most important item in this process. Upon it depend to a very large extent the character and quality of the resulting picture. The acetic bath is a weak solution of acetic acid and a reducing agent such as hydroquinone or ferrous sulphate, or a combination of the two. The power of controlling results, and of effecting a desired modification in the gradation of the initial photograph, depends upon the proportion of the acetic acid in reference to the reducing agent. Opinions as to the action of the solution may differ, but the theory upon which I have recently worked is that the acetic acid in presence of the manganic oxide converts the chromic oxide into chromic acid, which, being soluble, is absorbed by the gelatine of the pigment plaster. The chromic acid, in its progress through the thickness of the gelatine, is reconverted by the reducing agent into chromic oxide, which is the substance that renders gelatine insoluble in the carbon printing process. It is very curious to note that in this way the acetic solution theoretically lifts some chromic oxide from the image into the pigment plaster by means of oxidation and reduction. Now let us consider the effects of the two chemical agents separately. If we employ acetic acid alone, chromic acid would be produced, and it would enter the gelatine; but not till after some considerable time would it render the gelatine sufficiently insoluble to stand development in hot water. A picture would be produced, but not a practically developable one. If the reducing agent alone be used, an undevelopable image would be formed, probably due to the disengagement of oxygen from the manganic oxide.

Let us now follow in our minds the progress of the reactions when a combination of acetic acid and a reducing agent is employed. First of all, the acetic acid in presence of the manganic oxide acts upon the insoluble chromic oxide, and converts it into a very soluble oxide called chromic acid. A solution of chromic acid is thereby liberated, and being surrounded by water, a reducing agent, paper, and gelatine, it is absorbed by the two latter, and the gelatine gets its fair share. But in its progress it meets the reducing agent, and becomes reduced to the insoluble chromic oxide, and thereby arrested in its travels. What we want is a gradual reduction of the chromic acid, so that we may allow it to travel a given distance, and no farther. In the deep shadows the chromic acid should penetrate nearly as far as the backing of the plaster before it is finally reduced. In the lighter parts of the print it should be reduced fairly rapidly. Suppose we use too much acetic acid and too little reducing agent: too large a proportion of chromic acid would be produced, and it would travel as far as the backing of the plaster, and then probably spread itself out before the reducing agent had time to arrest its progress. In such a case the backing of the plaster would be difficult to remove, the shadows would appear as if over-printed, and the outlines would be blurry, in consequence of the spreading of the mobile chromic acid. Again, let us suppose we were to use too much reducing agent and too little acetic acid. For this example we will take ferrous sulphate, for reasons which will be explained later. The progress of the chromic acid would be rapidly arrested, and it might possibly only enter the gelatine in the deeper printed parts. In the high-lights it would probably be reduced before it entered the pigment of the gelatine, and the picture would look flat, but what there is of it would be extremely sharp. Our endeavour, therefore, should be to avoid these two extremes, and to so adjust the proportion of the acetic acid and reducing agent that we may produce a combination which, with reference to the distribution and amount of the chromic and manganic oxides of the print, would effect the desired result.

Various reducing agents may be employed, but some of the phenol-derived developers, such as amidol, metol, pyrocatechin, pyrogallol, etc., form, after a short time, strongly coloured solutions with ferrous sulphate.

Ferrous sulphate is a very strong reducing agent, and should be used in the proportion of about one part to five parts of acetic acid. It has, moreover, a quality which is very useful in Ozotype—the product of its oxidation being an insoluble and very stable oxide called ferric oxide, which settles upon the image and causes the gelatine to attach itself to the smallest details with sufficient tenacity to allow of considerable mechanical development.

Hydroquinone does not appear to be so powerful a reducing agent as ferrous sulphate, and as a general guide should be used in the proportion of two parts to five parts of acetic acid. The reduction of the chromic acid is slower than in the case of ferrous sulphate, and consequently the shadows are richer in colour, from the fact that the chromic acid has time to penetrate some distance into the pigmented gelatine before being finally reduced. But if too much hydroquinone be used, it would convert too much of the manganic oxide of the initial photograph into a soluble salt, and there would be some difficulty in preserving the very light details during development.

From the above considerations, and after many experiments, I have come to the conclusion that a combination of the rich shadow-producing qualities of hydroquinone and the detail-preserving properties of ferrous sulphate would give the best result, and a good acetic solution for prints from good negatives would be:—

Water	40 ounces.
Glacial acetic acid	60 minims.
Hydroquinone	15 grains.
Ferrous sulphate	10 ,,

Several other formulæ will be given at

the end of this section to meet the case of prints obtained from abnormal negatives.

The acetic acid should be that quality known as "glacial."

The ferrous sulphate should be purchased in the special pure granular form, costing about ninepence per pound, as in this form it is much easier to weigh out in grains and to dissolve than in ordinary crystals. Its trade name is "special pure granular protosulphate of iron."

In making up the acetic solution, pour the required quantity of water into a bottle and add the acetic acid. The other ingredients, should then be added to the acidulated water, taking care that they are thoroughly dissolved before using. It is a good plan to make the solution in about ten ounces of warm water, and when the ingredients are dissolved, to fill up to forty ounces with cold water.

The acetic solution will keep good for about a week. After two or three days it turns brown owing to oxidation, but it does not appear to be much less useful in this condition.

Below are given a few formulæ for the treatment of prints from various qualities of negatives, but it must be borne in mind that they are merely suggestions, and that some scope is left to the intelligence of the operator to meet particular cases.

For prints made from thin negatives, such as those generally used for cabinet portraits on P.O.P., (care should be taken not to over-expose) :—

Water	40 ounces.
Glacial acetic acid	80 minims.
Hydroquinone	15 grains.
Ferrous sulphate	10 ,,

For prints from brilliant negatives, such as those suitable for carbon printing :—

Water	40 ounces.
Glacial acetic acid	60 minims.
Hydroquinone	20 grains.
Ferrous sulphate	10 ,,

For prints from weak, over-exposed negatives :—

Water	40 ounces.
Glacial acetic acid	90 minims.
Hydroquinone	25 grains.
Ferrous sulphate	1 grain.

Many other variations of the ingredients will no doubt suggest themselves to workers after a little practice, and they will soon find out for themselves the particular acetic bath to suit their special negatives and paper.

There is another method of controlling results which must not be overlooked. This consists in coating the paper strongly or weakly with the sensitising solution to suit any special negative. When very thin negatives are used, and it is desired to produce strong prints, the paper, after having been coated as described under that heading, and dried, should be treated with an additional coat of about one-third of the original quantity of sensitising solution. Where the negative is too strong, and soft prints are required, the sensitising solution may be diluted with 20 per cent. of water. When a strongly sensitised surface is used under a weak negative, a short exposure should be given.

THE OPERATION OF PIGMENTING.

Having made up the acetic solution, place the gas or oil stove upon a table, and lay upon it the asbestos cardboard or safe-boiling stove mat. Upon this place the porcelain dish and pour into it the acetic solution to a depth of about an inch and a half to two inches, then immerse the bulb of the thermometer and place the squeegee board upon the same table on the right hand of the stove, with the squeegee ready at hand. On another table the washed prints and pigment plasters should be arranged; also a quire of blotting-paper. Now light the stove, and as soon as the temperature of the solution is raised to 65°, extinguish the fire, and you will find that the temperature will go up a further 5° or 7° if the asbestos mat is used. Of course the heating of the solution is not necessary in summer time, when the ordinary temperature of water is 68° or 70°. For very rough papers the temperature should be raised to 76° to 78°, but no higher, or the gelatine will melt.

Having everything ready, we will now proceed to the practical operation of causing the pigment plaster to absorb the solution which is to act on the image. Take a piece of pigment plaster the size of the print, and having wiped it with the clean cloth or velvet brush, immerse it (coated side downwards) in the acetic solution. At the expiration of about half a minute, turn the plaster face upwards, taking care that it is under the surface of the solution. If there are any air-bells, now is the time to remove them. A camel-hair brush or the finger may be used for this purpose.

At the expiration of another thirty seconds the plaster will be fairly soft and pliable. Now take a print and plunge it face downwards under the surface of the solution, and (avoiding air-bells) bring it in contact with the gelatine surface of the plaster, then grasp the two top corners of the plaster, and placing the thumbs on the corners of the print, bring both the print and plaster clinging together out of the solution, and lay them down upon the squeegee board, plaster uppermost, and long sides right and left. Then without losing any time take the squeegee and firmly but gently press them together, by passing the squeegee several times from nearly the extreme left to the extreme right, finishing up with a few back strokes from right to left. Now place the print with its adherent plaster between blotting paper to remove superfluous moisture, and hang up to dry by means of dark-room pins on the edge of a shelf, or on a line by the aid of wooden clips. The plaster should not be kept in the acetic solution for more than two minutes at most, and the print should be immersed as little time as possible, as the image is acted upon at once by the solution. When dry, the plastered print may be developed at once, or it may be left for any convenient time.

PRACTICAL INSTRUCTIONS WITH REGARD TO DEVELOPMENT.

Having had only short intervals of time at my disposal, I have invariably pigmented my prints one evening and developed them the next day or a week after, and I think it does not matter how long the plastered print is kept previous to development. With regard to carrying out the development before the plaster is dry, I have only made a few experiments, but my opinion is that the picture can, with certain precautions, be developed within an hour after the application of the plaster. The immersion in cold water, I find, is necessary.

However, let us suppose that the print is dry. To begin with, put the prints into a vessel of cold water and let them remain there for about twenty minutes in summer, or thirty minutes in winter. In the meantime get your stove, developing tank, thermometer, zinc plates, and tin mug ready. Place your developing vessel over your stove. If you have hot water handy, pour a sufficient quantity into the tank to occupy a depth of four to five inches. Immerse the bulb of your thermometer and note the temperature, which should be from 106° to 108° Fahrenheit. If hot water is not easily procurable, the stove must be used to raise the temperature.

Wait until your prints have been soaked in the cold water for the required time, and then they will be ready for the removal of the plaster backing, which is performed as follows :—Take two of the prints out of the cold water and plunge them under the surface of the warm-water bath. In about one minute after immersion take one of the prints with the plaster side uppermost, and by picking up a corner of the plaster and holding the print firmly in the left hand, peel off the paper backing of the plaster and throw it away. This operation requires more pulling force than in the ordinary carbon process, and should be done under the surface of the water, straight off, without any stopping.

It will now be seen that nearly all the gelatine has attached itself to the print, and that the plaster backing shows an impression of the image. The print should now be hung up or laid upon blotting-paper until the remainder of the batch has been treated in the same way. The second print which was put in the hot water will now be ready to be treated in the same way, and if one print is transferred from the cold to the hot water just before the one in the hot water is ready to strip, much time will be saved. As it is not advisable to keep the plastered prints in the cold water too long, any remaining prints had better be taken out and laid upon blotting-paper to await the removal of the plaster backing.

The next operation—namely, the development of the picture—is a fascinating occupation, and as it is performed in full daylight or gaslight and the water is of a nice temperature, it is also pleasant and convenient. First see that the temperature of the water in the developing tank is about 105° Fahrenheit. Plunge one of the prints from which you have removed the plaster backing into the hot water face downwards, and leave it there for about one minute, or until the gelatine has become loosened; then turn it over, and take one of the zinc plates (the size of the print) and place it underneath the print, so as to form a rigid backing, and by holding the print on to the plate by two opposite corners with the thumbs, move it upwards and downwards in the bath until the whole mass of gelatine apparently begins to dissolve. Now take your little mug and wash away all soluble gelatine by pouring mugs full of the warm water over the picture until it is fully developed. Should the picture not develop easily, leave it in the warm water for a little time longer, and it will develop much more quickly with the mug afterwards.

You should now have a picture in which the shadows are raised up from the paper in consequence of the swollen condition of the gelatine. If the development is judged to be complete, the picture may be at once immersed in a cold bath consisting of—

Water	40 ounces.
Alum	1½ ounce.

But it is sometimes convenient to allow the picture to dry without the alum bath, so as to allow of subsequent local development, as the appearance of the dried print is different from that on which the gelatine is in a swollen condition. But it is essential that the alum bath should be used before mounting the picture. Any manganic or ferric oxide that may possibly remain after the development of the picture can be entirely removed by adding a little oxalic acid (say two drams to forty ounces) to the alum bath, and when this is done the only chemical substance remaining would be a very minute proportion of chromic oxide which has not been oxidised by the acetic solution.

MOUNTING THE PICTURE.

The pictures may be mounted wet or dry. I prefer the wet method, as the print is then in a pliable and ductile condition, giving every facility for close adhesion to the mount. It is conducted as follows :—Immerse the picture in the alum bath for about ten minutes and wash it in a change of clean water. Bring it out of the water and surface-dry it between good white blotting-paper. Lay it face downwards upon a slab of glass and paste the back with Higgins's mountant. Lay the pasted print on the mount in the proper position, and then with a soft moist sponge dab very lightly over the picture until it is quite flat on the mount. Squeeze the sponge in clean water and remove all superfluous mountant. If there are any small specks of moisture still adhering, they may be removed by flapping the picture with a dry soft silk handkerchief. The slab of glass used for pasting should be cleaned every time it is used for the purpose.

POSSIBLE DIFFICULTIES AND THEIR REMEDIES.

The backing of the plaster is difficult to pull off, and sometimes tears in the operation. This is caused in most cases through over-printing. The remedy, of course, is not to print so deeply; but a longer soaking in cold water and using the developing bath at a higher temperature will mend matters. It is necessary to point out that if only a portion of the backing be removed and the remainder refuses to strip, the print should be immediately returned to the cold-water bath for a longer immersion, as if kept in the hot water the uncovered portion would go on developing. This difficulty may also arise from too long immersion of the plaster in the acetic bath.

White specks. — Imprisoned air-bells cause white specks, but these can be detected by their circular appearance. There are sometimes, however, other angular white specks, due to the gelatine failing to adhere properly to the image, and being pulled up during the removal of the plaster backing. These occur sometimes on rough papers which have not had a preliminary sizing, and also when ordinary carbon tissue is employed for pigmenting.

The remedy is to size all rough papers which are not well sized in their manufacture, and to see that the temperature of the acetic bath is from 75° to 78°. One dram of glycerine added to forty ounces of the acetic solution will probably mend matters.

Sometimes on removal of the plaster backing in the developing water dark rings of pigment with white centres appear on the print. This is due to too long immersion in the hot water before the removal of the backing, or the temperature of the water is too high. These rings occur only in the high-lights of the print, and are caused by the gelatine melting in those places and dropping the pigment. These marks can as a rule be removed by dashing the hot water against them with the mug.

Although in this process a very considerable amount of control can be exercised in modifying the character of the resulting picture, it is like every other photographic method—the best negative will produce the best initial print, which will be the easiest and most satisfactory to pigment.

NOTES FOR BEGINNERS.

Beginners will probably experiment in half-plate size. They had therefore better try a paper which is sufficiently sized in the manufacture for this process. A very fine well-calendered cartridge is a good paper to use for small work. There is also a coated collotype paper, called "Excelsior collotype thick calendered printing paper," sold by Messrs. Penrose & Co., of Upper Baker Street, London, W.C., which gives very pleasing results; but be careful not to get the "process" printing paper, the dressing of which decomposes the sensitising solution. The single transfer paper employed in the carbon process I have not found entirely satisfactory, the surface being sometimes too hard and repellent to hold the high-lights of the picture during development. In coating surfaced collotype papers, use a three to three and a half-inch bear's hair brush, and lay the solution on with a light hand. The printing should be carried out in a fairly strong light, until the details in the high-lights are just visible.

The acetic bath need not be heated if the weather is at all warm.

For prints from negatives that have been made for P.O.P. printing, the composition of the acetic solution should be—

Water	40 ounces.
Glacial acetic acid	80 minims.
Hydroquinone	20 grains.
Ferrous sulphate	5 „

The acetic acid should always be added before the other ingredients.

The plastered prints should not be soaked for more than half an hour in the cold water in summer weather.

The temperature of the developing water should be between 104° and 107° Fahrenheit.

ANILINE-COLOURED PICTURES FROM OZOTYPE PRINTS.

The manganic oxide contained in an Ozotype print can be made to liberate a part of its oxygen by treating it with a dilute solution of some of the strong acids. This circumstance can be taken advantage of in several ways. The soluble salts of aniline produce a variety of colours by different degrees of oxidation, and if a solution of aniline salt rather strongly acidulated with sulphuric, hydrochloric, or nitric acid be applied to an Ozotype print, the image is changed to a beautiful green colour, which appears to be fairly permanent. This green colour can be changed to a rich blue, blue-black, or mauve by simple immersion in various chemical solutions.

For producing a green picture, immerse the washed print in the following solution :—

Water	20 ounces.
Aniline hydrochloride	1 ounce.
Sulphuric acid	30 minims.

For blue pictures, wash the green print obtained as above, and immerse in a solution of—

Water	20 ounces.
Cupric chloride	1 ounce.

For blue-black pictures, add to the above cupric chloride solution one drop of saturated solution of potassium bichromate.

For mauve pictures, wash the green image produced as described, and immerse in a solution of—

Water	20 ounces.
Carbonate of soda...	1 ounce.

As these colours change slightly if kept too long in water, a short, vigorous washing is advisable.

This is as far as I have experimented in this direction, but there is a wide field for further investigation. There are several other phenol- and naphthol-derived salts possessing a colour-giving element which might be used with effect, or certain aniline dyes might be rendered colourless by reduction, and then oxidised into colour again by the image. Transparencies in aniline colours would be very effective, and I have no doubt could be easily made.

POSSIBILITIES OF OZOTYPE.

Some of my readers will no doubt wonder why the gum method of pigment printing could not be adapted to this process. As far as I can see, there is no reason whatever why pigmented gum should not be used in place of gelatine. It is only through want of time and experience in gum printing that I have not experimented much in this direction. That the image produced by the Ozotype process will render gum arabic comparatively insoluble by treatment with a strong acetic solution is a fact, for I have tried it several times. Apart from the advantage of a visible image to start with, the picture would possess better gradation than in the present method, from the fact that the development would be carried out on that surface of the gum coating which is at the back of the impression of the image.

The possibilities of an entirely new photographic image having oxidising properties are so great that for the sake of science alone further researches into the subject should not be left to only one person to carry out.

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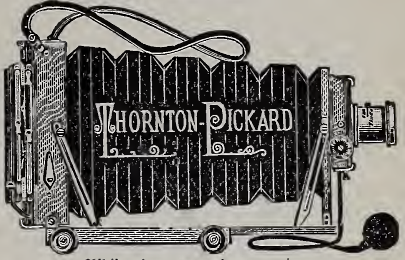

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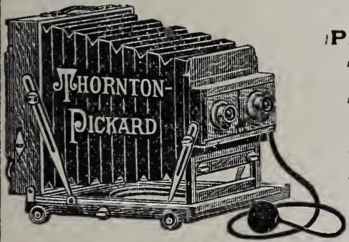

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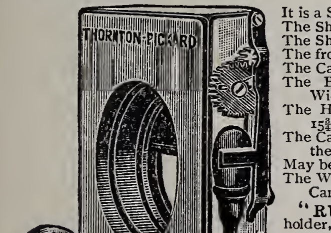

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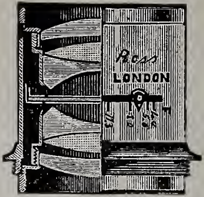

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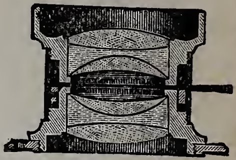

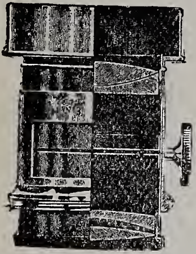

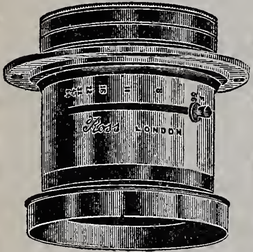

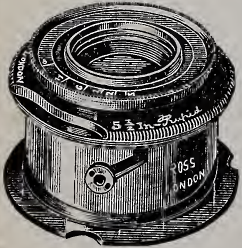

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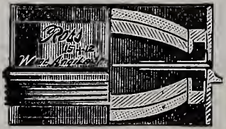

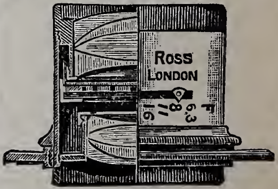

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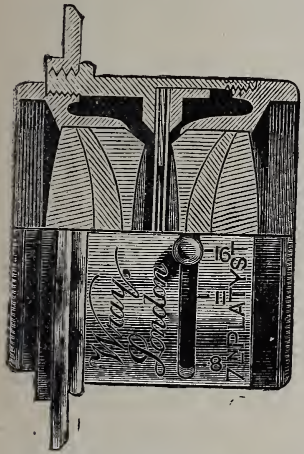

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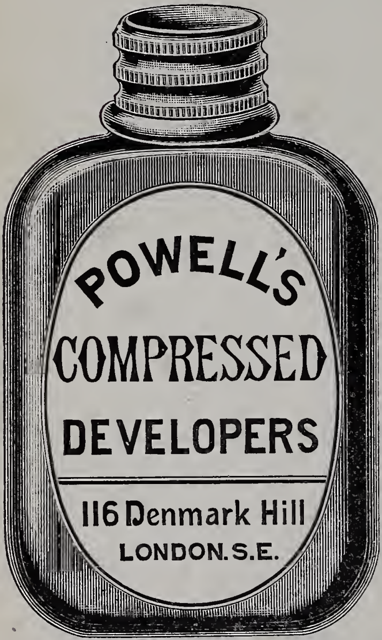

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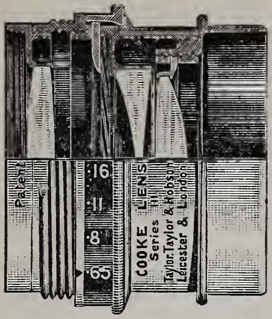

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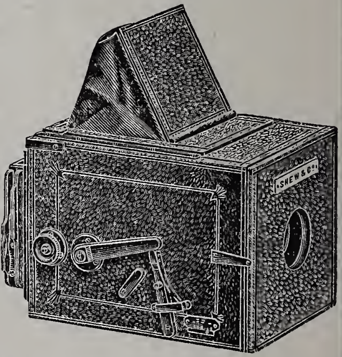

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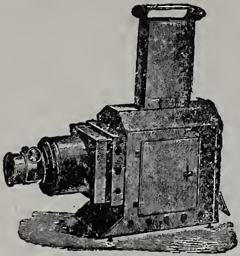

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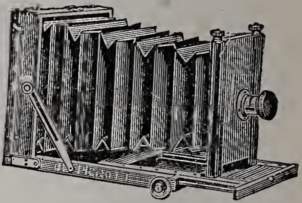

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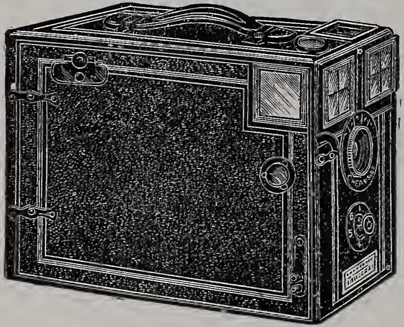

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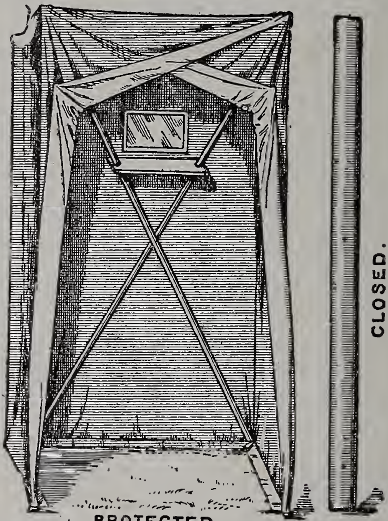

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